the same imaging dose to the patient. The objective of the present study was to investigate the effect of using different pulse current and time combinations for CBCT acquisition, and provide local guidelines on how to choose the x-ray current/time.

Materials and Methods: All CBCT scans were acquired on Elekta Synergy or Versa HD accelerators equipped with the XVI 4.5 CBCT system. Three series of 200 projection images were acquired without a phantom on the treatment couch, using different combinations of pulse current and time to provide an x-ray intensity of 0.4 mAs per projection image. All three series were acquired at 120 kVp with the S20 F0 filter combination. The pulse current/time combinations were 10mA/40ms, 20mA/20ms and 40mA/10ms. To further investigate the potential effect on the reconstructed image quality, two CBCT scans of a cylindrical water phantom (20 cm diameter, 48 cm length) were acquired at 120kVp using the S20 F0 filter combination. 200 frames were acquired over an arc of 200 degrees, and projection images were exposed to 10mA/40ms in the first scan and 40mA/10ms in the second scan.

Results: Plotting the mean signal in each projection image of the open scans as a function of projection image number revealed that the shorter pulse times had larger signal variation between the projection images. On top of this, a series of sudden spikes was observed for the 10ms pulse time, and these were completely removed when using the 40ms pulse times. The latter, more consistent x-ray output from the generator will in theory provide a less noisy CBCT reconstruction. Reconstructions of the two scans of the water cylinder are shown in the figure below. It is evident that homogeneity and image noise is reduced when using the long pulse time compared to the short pulse time. These effects are most substantial towards the outer edges of the reconstructed volume, where the undersampling of the data required for reconstruction becomes more severe.

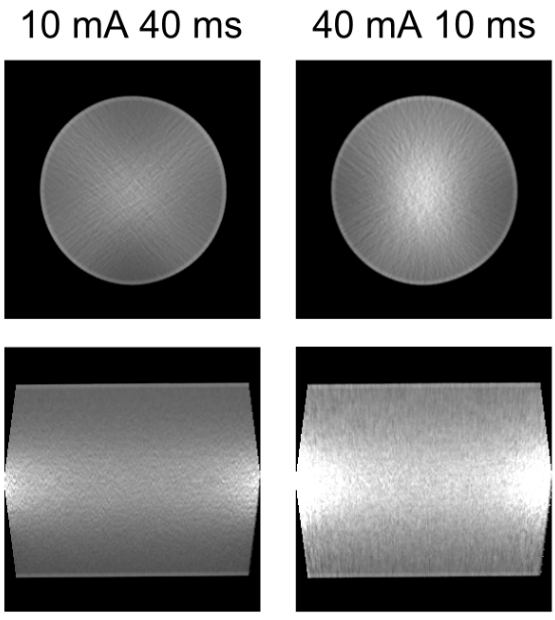

Figure: Axial and coronal view of a homogeneous water cylinder. All images are displayed with the same window/level settings.

Conclusions: The use of longer pulse times and lower pulse currents when acquiring CBCT projection images was found to improve image quality in the reconstructed CBCT volume. Based on this finding, our clinical CBCT acquisition protocols were changed to use the longest possible x-ray pulse times while keeping the imaging dose the same as before this study. We have not observed a significant improvement in image quality of patient CBCTs, possibly because there are other more severe sources of image noise in the system. The change to longer pulse times is however a quick fix in changing the acquisition protocols once, and does not increase the CBCT scan time as the x-ray pulse time remains much shorter than the frame time of the XVI system.

EP-1537

A study of accuracy evaluation of dose distribution calculation based on the cone-beam CT

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Purpose/Objective: The target of this study is to evaluate the accuracy of the dose distribution calculation based on the CBCT by converting the pixel values using a histogram of pixel values of the simulation CT and CBCT.

Materials and Methods: The simulation CT images and the CBCT images just before treatment of 10 prostate cancer patients have been acquired. It is not sufficient to calculate the dose distribution directly using the pixel values of the CBCT, because of insufficient calibration of the pixel values in the CBCT. The pixel values in the CBCT images were converted using an in-house program. Original treatment plans consisting of seven fields were created on the simulation CT images. These plans were applied to the CBCT images and the dose distributions were re-calculated with same monitor units (MUs). These dose distributions were compared with original dose distributions.

Results: The results of the pixel value conversion were as follows. The mean differences of pixel values for the prostate, subcutaneous adipose, muscle and right-femur were -10.78±34.60, 11.78±41.06, 29.49±36.99 and 0.14±31.15, respectively. In the results of the re-calculated dose distributions, the mean differences of prescription doses for seven fields were 4.13±0.95%, 0.34±0.86%, -0.05±0.55%, 1.35±0.98%, 1.77±0.56%, 0.89±0.69% and 1.69±0.71% respectively. As a whole, the difference of prescription dose was 1.54±0.4%.

Conclusions: The dose distribution re-calculation on the CBCT images achieves an accuracy of <2% by using an in-house program to convert pixel values. This method may be able to efficiently allow the implementation of adaptive radiation therapy.

EP-1538

Organ and effective dose from kV stereoscopic imaging as part of image-guided radiotherapy: a Monte Carlo study

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Purpose/Objective: This study aims to quantify the organ and effective doses from BrainLab ExacTrac x-ray exposures

during cranium, head and neck, thorax and prostate imaging using PCXMC, a Monte Carlo computer program. The organ doses will be compared with published organ doses resulting from cone-beam CT and MV planar imaging.

Materials and Methods: The half-value layer, total filtration, radiation output and peak kilovoltage of the x-ray beams were measured using an Unfors Xi meter. Entrance dose, entrance field-size and focus to skin distance were calculated for each clinical protocol and used as input to PCXMC simulations. Clinically-representative beam directions and angles were used. Absorbed dose to each simulated organ and effective dose were calculated from a pair of ExacTrac exposures for each anatomical protocol.

Results: The maximum organ dose was 0.4 mGy to the kidneys from the prostate protocol. The maximum effective dose of 0.1 mSv was also from the prostate protocol. The maximum organ dose from a pair of ExacTrac images is between 27 and 128 times lower than published organ doses resulting from a single cone-beam computed tomography scan, and 250 times lower than doses from a single MV planar-imaging procedure published in the literature.

Conclusions: This study has shown that PCXMC can be used to estimate organ and effective doses from ExacTrac use. Organ doses from ExacTrac are low compared with those from cone-beam CT and MV planar-imaging.

EP-1539

The dosimetric effect of a metal artifact reduction algorithm for head and neck RapidArc treatments

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Purpose/Objective: The presence of dental implants or fillings affects the image quality of the planning-CT (pCT) of head and neck (H&N) patients by causing scatter and beam hardening artifacts. These artifacts can cause inaccuracies in the dose calculation of the radiation therapy treatment plan, in particular if a deterministic dose calculation algorithm is used (Acuros XB [AXB; Varian Medical Systems Inc., Palo Alto, USA]).

A recent commercially released CT reconstruction algorithm (MAR; General Electric, Milwaukee, USA) greatly reduces metal artifacts and thus hypothetically improves the accuracy of the dose calculation for patients with dental fillings or implants.

Applying a density override (DO) for the scatter regions is another often used solution to reduce the influence of metal artifacts on the dose calculation. We studied the effect of density overrides, the use of MAR and the combination of both on the dose distribution for H&N cancer patients with dental fillings treated with RapidArc (RA) radiotherapy.

Materials and Methods: For five H&N cancer patients with dental implants and/or fillings near the location of the tumor an additional MAR-CT reconstruction was acquired after the pCT was obtained. For each patient 4 different datasets were generated: 1)pCT without DO; 2)pCT with DO; 3)MAR-CT without DO; 4)MAR-CT with DO. Dataset 4 was used as the reference dataset. For each dataset a treatment plan was created using our standard clinical optimization protocol and calculated on the reference dataset using AXB.

For all plans DVH parameters (D_{max}, D_{mean}, $D_{2\%}$, $D_{98\%}$ and the $V_{95\%}$) for PTV_{boost} and $PTV_{scatter}$, which represents only that part of the PTV_{boost} which is affected by scatter, were reported and compared to those of the reference dataset. Also, differences in dose to the OAR, the ipsi- and contra-lateral parotid gland and the contra-lateral submandibular gland were reported in terms of D_{max}, D_{mean} and $D_{2\%}$.

Results: Preliminary results for 1 patient show limited differences in PTV coverage between the 3 datasets and the reference dataset. The D_{max} of the PTV_{boost} differed 1% at most, and the $PTV_{scatter}$ shows an increase in D_{max} of 1.4% for the treatment plan based on the pCT without DO (Table 1, Figure 1). Larger differences were found for the OAR's. The D_{mean} of the contralateral submandibular gland was found to be 47 cGy, 90 cGy and 170 cGy higher for dataset 3, 1 and 2 respectively.

	PTV_{boost}	$PTV_{scatter}$	$OAR_{parotid\ ri}$	$OAR_{parotid\ le}$	$OAR_{subman\ le}$
$D_{max\ (cGY)(\%)}$	7888 (0,4)	7851 (1,4)	7599 (2,7)	6175 (1,9)	6201 (2,2)
$D_{mean\ (cGY)(\%)}$	7269 (1,0)	7281 (1,2)	3926 (2,1)	2469 (0,3)	3456 (2,7)
$D_{2\%\ (cGY)(\%)}$	7625 (1,0)	7612 (1,2)	7268 (1,6)	5655 (0,7)	5887 (1,1)
$D_{98\%\ (cGY)(\%)}$	6506 (0,6)	6818 (1,1)			
$V_{95\%\ (\%)}$	97,4 (0,4)	99,3 (0,4)			

Table 1: Dose information pCT without DO and percentage difference compared to MAR-CT with DO

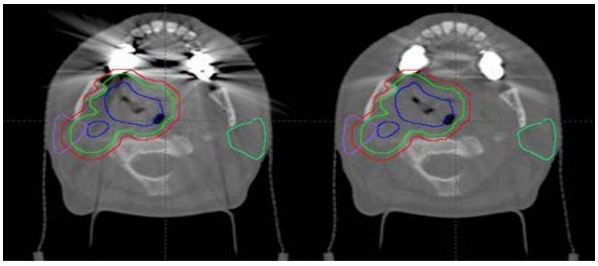

Figure 1: Planning-CT (left) and MAR-CT reconstruction (right) visualized with the contoured GTV (blue) , CTV_{boost} (green) and PTV_{boost} (red) , and both parotid glands (purple and lime).

Conclusions: Although there is an increase in mean dose of the OAR's when MAR, a density override or a combination of both is omitted, the differences in dose distribution between the several methods are small and not clinically relevant.

EP-1540

Validation of ARTFiBio registation software. Comparative with comercial software and shared datasets

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Purpose/Objective: The objective of the ARTFiBio project is to establish an integrated information network from which they can develop predictive models of tumour response based on functional data in vivo and to share datasets, and registration and predictive tools with the scientific community.

In order to relate information from multiple imaging modalities (PET, CT y MRI) at different stages of treatment (through time) a robust registration scheme is critical. We present results of a comparison ARTFIBio tools with the